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A Study Of Age At Menarche And Body Composition In School Girls Of Metro cities

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Abstract

Two thousand and seventeen subjects of various schools from two important metro cities in Maharashtra namely Mumbai and Pune in the age group of 10-14 year were studied to examine association between age at menarche and body composition. Data was collected through General Questionnaire & their body composition was assessed using analyzer (Tanita model no. BC 420 PM A). Out of the total sample, 370 students with mean age 12.35 year ±1.009 had attained menarche (AM) in the recent period of their recruitment whereas 1,646 girls had not attained menarche meaning they were perimenarcheal (PM) at the recruitment with mean age 11.42 year ±1.065. A concerning fact established by our study was that 10% of girls from our population had attained menarche when they were just 11 yrs and 52.18% girls had attained menarche before they were 12 years of age. Results showed that All the body composition parameter except total body water percentage (TBW %) were higher in AM group compared to PM group. It was observed that fat percentage and fat mass was negatively correlated with age at menarche which was statistically significant at 0.01 levels. Fat free mass, muscle mass, TBW (kg) were weakly negatively correlated whereas TBW (%) was positively correlated with age at menarche which was statistically significant at 0.01 levels.

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1. INTRODUCTION

Menarche is the first menstrual cycle which denotes the start of the reproductive capacity. It is a vital maturational event of puberty in female adolescents. Early as well as late age of menarche both have significant health consequences. The age at menarche seems to be extremely important. Early age of menarche seems to be associated with breast cancer risk1 whereas late age at menarche is related to Alzheimer's disease as well as osteoporosis2.Various genetic and environmental factors interact with each other and influence the age at menarche3. During the 19th century, factors such as climate, ethnicity, socio-economic status, urban or rural residence, physical activity, education, sexual stimulation, housing, genetics and health status were considered to be the determinants of age at menarche. Moving ahead in the 20th century, studies reported additional influencing factors such as season and month at birth, physique, family income, profession and education of parents, and family size. Estimated drop in the age at menarche during most of the 20th century was about 3 months per decade which was attributed to striking improvement of socioeconomic status and general health of the populations in the Western countries4.

One of the important factors impacting age at menarche is the composition of the body. It is the technical term used to describe the different body compartments such as lean mass, fat mass, body water and bone mass that make up the human body weight. According to some researchers, a minimum level of fatness (17% of body weight) is associated with menarche; however, a heavier minimum weight for height, representing an increased amount of body fat (22%), appears necessary for the onset and maintenance of regular menstrual cycles.5

Prepubertal body composition appears to influence how quickly girls and boys progress through puberty and is thus more strongly related to puberty duration and age at which pubertal characteristics appear6. Body composition during puberty is thereby a marker of metabolic changes that occur during this period of growth and maturation, and, thus, holds key information regarding current and future health.

It is overall observed that age of menarche and the factors affecting it are well researched in Western countries, but substantial data is unavailable pertaining to Indian population. Hence, this study was taken in an effort to substantiate the available Indian data. The objectives for the study were,

- To record age of menarche in the given population
- To assess various parameters constituting body composition
- To correlate age of menarche with body composition parameters of girls in the age group of 10 – 14 years.

2. RESEARCH METHODOLOGY

This was action research approved by Inter System Biomedica Ethics Committee, Kasturba Health Society, Vile Parle (W), in which combination of the retrospective and prospective methods were used.

2.1 Selection of the sample

School girls in the age group of 10-14 years (5th-8th standard) from various schools of two important metro cities in Maharashtra namely Mumbai, Pune were selected for the study. After obtaining formal consent from the respective school principals a preparatory talk in different sessions was given to them. In this they were introduced to physiological and anatomical changes taking place during puberty, the onset of menarche and the menstrual cycle. Based on the girls and their parental willingness to participate in the study final sample of 2017 subjects were enrolled for the study.

2.2 Tools of Data Collection

- **Screening Questionnaire:** This included the date of birth as well as date of menarche if it was recently attained. Based on menarcheal date, the subjects were divided into two groups, those who had recently attained menarche (AM), and those who had not attained menarche and hence were peri-menarcheal (PM).
- **Body composition analysis:** It was conducted using a Body composition analyzer Tanita model no. BC 420 P MA. It works on the principle of Bio Electrical Impedance. The general principle behind BIA: two conductors are attached to a person's body and a small electric current is sent through the body. The resistance between the conductors will provide a measure of body fat, since the resistance to electricity varies between adipose, muscular and skeletal tissue. Fat-free mass (muscles) is a good conductor as it contains a large amount of water (approximately 73%) and electrolytes, while fat is anhydrous and a poor conductor of electric current. While conducting the analysis the girls were asked to stand on the machine bare feet wearing their uniforms, the age in years and height in cm were entered manually. The values and measurements were done for the following parameters, Weight (kg), BMI (kg/m2), Skeletal Muscle Mass (kg), Fat Mass (kg), Fat Percentage, Total Protein (kg), and Total Body Water (kg).

3. RESULTS AND DISCUSSION

Out of the total 2017 subjects, 18% (n=370) had attained menarche (AM) in the recent period when they were recruited for this study whereas 82% (n=1,647) girls had not attained their menarche (PM).

3.1 Age wise distribution of Mean Menarcheal Age

The study samples belonged to standard 5th to 9th and majority of the population belonged to the age group of 10-14 yrs and specifically maximum girls fell in the age group of 12-13 yrs. The mean age of the study population was 11.59 yrs ± 1.114.

The mean age at menarche of the sample (n=274) was 12.16 yrs ±1.132. Out of this almost 50% students attained menarche between 11-12 yrs, 36.5% of students acquired it between 12-13 yrs and 12% of the girls had age at menarche above 13 yrs of age.

Table 1: Age wise distribution of Mean Menarcheal Age

Age (years)	N	Mean ± SD
10 yr	8	10.18 yrs ± .139
11 yr	27	11.07 yrs ± .698
12 yr	108	11.61 yrs ± .872
13 yr	100	12.79 yrs ± .697
14 yr	31	13.55 yrs ± 648
Total	274	12.16 yrs ± 1.132

From the above table it is evident that 143 out of 274 (52.18%) girls had attained their menarche before they were 12 yrs of age. This is a significant finding which substantiates the changing trend in today's Indian society so far as lowering of menarche is concerned. Out of the total population 10% of the girls had attained menarche at age 11 which is very concerning.

3.2 Assessment of Body Composition for the study population

Body composition was assessed using BIA principle with the help of Tanita body composition analyzer. Given Below are the mean ± SD figures for various parameters tested in both the population groups (Table 2).

Table 2: Comparison of various Body Composition parameters of both groups

Parameter Tested	AM Mean ± SD	N	PM Mean ± SD	N
Fat (%)	26.016 ± 8.70	370	21.191 ± 9.45	1647
Fat Mass (kg)	12.322 ± 6.55	370	8.412 ± 5.56	1647
Fat Free Mass (kg)	32.119 ± 4.06	370	28.228 ± 4.52	1647
Muscle Mass (kg)	30.334 ± 3.66	370	26.677 ± 4.18	1647
Total Body Water (kg)	23.667 ± 3.21	370	20.678 ± 3.31	1647
Total Body Water (%)	54.125 ± 6.32	370	57.792 ± 6.30	1647

It is evident from the above table that all the body composition parameter except total body water percentage (TBW %) were higher in girls attaining menarche. The theory of Frisch and Revelle (1970) also suggest that menarcheal age is related to attainment of appropriate weight for reproduction rather than appropriate skeletal status.[5] During adolescence, usually from 10 to 15 years, a girl grows by 9.25 inches and gains 46 pounds. This weight gain is mainly caused due to changes in body composition.

Correlation between various body composition parameters and age at menarche was tested using Karl Pearson's coefficient of correlation. Following results were obtained (Table 3):

Table 3: Correlation between Age at Menarche with Body Composition Parameters

Parameters Tested	Pearson Correlation		
	N	Pearson Correlation Coefficient	Sig. (2-tailed)
Fat (%)	274	-.206**	.001

Fat Mass (kg)	274	-.184**	.002
Fat Free Mass (kg)	274	-.005	.933
Muscle mass (kg)	274	-.032	.595
Total Body Water (kg)	274	-.023	.700
Total Body Water (%)	274	.208**	.001

It was observed that fat percentage and fat mass was negatively correlated with age at menarche which was found to be statistically significant at 0.01 levels. Fat free mass, muscle mass, TBW (kg) were weakly negatively correlated whereas TBW (%) was positively correlated with age at menarche which was found to be statistically significant at 0.01 levels. There are some studies which are in agreement with this finding. Siervogel (2003) has shown that greater TBF, FFM and body fat higher in girls with an earlier age of menarche and onset of puberty than their later-maturing peer[7] and acquiring an optimum amount of body fat and body weight is essential for the sexual maturation of the individual which is an important factor for onset of menses[8] (Matkovick, 1997).

Along with TBF distribution of fat in the body is very important. Higher the fat storage in the body there is earlier maturity resulting into early menarche. This study suggested that while the total estimated amount of body fat and weight are not significant predictors of menarche when added to skeletal growth, the distribution of body fat, as indicated by the relative amounts of upper-body and lower-body fat, is significantly related to menarche, especially in young women who reach this reproductive landmark with unusually low levels of total body fat. This suggests that body fat distribution may influence the timing of menarche although, alternatively, there may be a pubertal mechanism that increases lower-body fat deposition concurrent with or after menarche[9] (Lassek, 2006).

3.3 Results Of Discriminant Analysis

Efforts were made to classify the body composition analysis data as per the chronological age of the study population. The following four tables show the age wise data collected (Refer to Table 4).

Table 4: Group Statistics of Body Composition Parameters according to Age

	Group Statistics- Age 10				Group Statistics- Age 11			
Parameters tested	AM Group		PM Group		AM Group		PM Group	
	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD	N	Mean ± SD
Fat (%)	16	22.62 ± 7.9	330	20.422 ± 8.2	51	27.40 ± 8.97	531	21.39 ± 8.84
Fat mass (kg)	16	11.18 ± 5.6	330	7.2 ± 4.6	51	12.92 ± 6.66	531	8.51 ± 5.59
FFM (kg)	16	30.41 ± 3.9	330	25.40 ± 3.4	51	31.21 ± 4.47	531	27.86 ± 4.14
Muscle mass (kg)	16	28.69 ± 3.6	330	24.03 ± 3.22	51	29.91 ± 3.36	531	26.33 ± 3.83
TBW (kg)	16	22.26 ± 2.8	330	18.62±2.5	51	23.32 ± 2.75	531	20.39 ± 3.05
TBW (%)	16	54.45 ± 5.8	330	58.31±6.1	51	53.22 ± 6.73	531	57.51 ± 6.46
	Group Statistics- Age 12				Group Statistics- Age 13			

Parameters tested	**AM Group**		**PM Group**		**AM Group**		**PM Group**	
	N	**Mean ± SD**	**N**	**Mean ± SD**	**N**	**Mean ± SD**	**N**	**Mean ± SD**
Fat (%)	138	26.29 ± 9.01	527	21.35 ± 8.75	118	25.69 ± 8.21	193	21.21 ± 13.86
Fat mass (kg)	138	12.64 ± 6.68	527	8.90 ± 5.93	118	12.14 ± 6.39	193	8.29 ± 4.86
FFM (kg)	138	32.33 ± 3.94	527	29.42 ± 4.56	118	32.43 ± 4.04	193	29.87 ± 3.97
Muscle mass (kg)	138	30.49 ± 3.67	527	27.79 ± 4.19	118	30.58 ± 3.74	193	28.24 ± 3.64
TBW (kg)	138	23.67 ± 2.89	527	21.55 ± 3.32	118	23.99 ± 3.82	193	21.90 ± 2.89
TBW (%)	138	53.84 ± 6.40	527	57.64 ± 6.41	118	54.39 ± 6.01	193	58.34 ± 5.57

As seen from the means of all the body composition parameters it is evident that all these parameters were found to be higher in girls who had already attained menarche at the respective ages compared to their peers who had yet to attain menarche. Thus, theories proposed by various researchers already put forth by us in review of literature and at other places are proved correct through our findings also. Early maturing girls not only have higher height and body weight but their fat mass lean body mass with fat percentage and overall body water percentage are substantially higher than the girls who mature late and reach this important landmark of menarche later.

When this age wise data was statistically analyzed using t-test for equality of means, following results are obtained which are depicted in the following table (Refer to Table 5):

Table 5: t-test for equality of means for effect of Chronological Age on Body Composition parameters

Parameters tested	**t-test for equality of means**	**Age in Years**			
		10 yrs	**11 yrs**	**12 yrs**	**13 yrs**
Fat (%)	T	2.458	4.627	5.871	3.186
	Df	344	580	663	309
	Sig. (2-tailed)	.014	.000	.000	.002
Fat mass (kg)	T	3.261	5.279	6.419	5.991
	Df	344	580	663	309
	Sig. (2-tailed)	.001	.000	.000	.000
FFM (kg)	T	5.610	5.477	6.869	5.450
	Df	344	580	663	309
	Sig. (2-tailed)	.000	.000	.000	.000
Muscle mass (kg)	T	5.608	6.425	6.884	5.451
	Df	344	580	663	309
	Sig. (2-tailed)	.000	.000	.000	.000
TBW (kg)	T	5.514	6.589	6.843	5.479
	Df	344	580	663	309
	Sig. (2-tailed)	.000	.000	.000	.000
TBW (%)	T	-2.478	-4.507	-6.208	-5.878
	Df	344	580	663	309
	Sig. (2-tailed)	.014	.000	.000	.000

So far as body composition is concerned above findings hold true for all other parameters which are highly significant at 0.01 level, but fat % and total body water % are not highly significant statistically. This suggests that probably at that age these two parameters do not have major effect in body composition modulation compared to other parameters.

4. CONCLUSION

Thus, to conclude, the present study has tried to explore the relationship between age at menarche and body composition in the Indian population specifically the school girls from Maharashtra. It was found that early maturing girls had substantially higher fat mass, lean body mass, with fat percentage and overall body water percentage than the girls who mature late and reach this important landmark of menarche. TBW (kg) were weakly negatively correlated whereas TBW (%) was positively correlated with age at menarche which was statistically significant at 0.01 levels.

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